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EFFECT OF WINTER RATIONS ON PASTURE GAINS OF CALVES.[1]

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I. WINTER RATIONS AND THEIR INFLUENCE ON PASTURE GAINS OF CALVES.

II. THE COST OF RATIONS FOR WINTERING CALVES.

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OUTLINE OF THE EXPERIMENTAL WORK.

The work reported in this bulletin is part of a series of experiments on beef-production problems in the Appalachian Mountain region that have been in progress since December 22, 1914, in cooperation between the Bureau of Animal Industry of the United States Department of Agriculture and the West Virginia Agricultural Experiment Station, on the farm of David Tuckwiller, in Greenbrier County, W. Va. This farm is located in the southeastern part of the State in the blue-grass area. The results of this experiment apply not only to West Virginia but also to the adjacent States

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[1] A report of cooperative work by the Bureau of Animal Industry, United States Department of Agriculture, and the West Virginia Agricultural Experiment Station.

[2] The authors acknowledge the services of W. F. Ward and F. W. Farley, formerly of the Animal Husbandry Division, who assisted in planning and carrying on the work.

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having similar conditions, as shown in figure 1. Some of the methods and results may be utilized to advantage by cattle feeders in other parts of the country.

THE REGION AND ITS PROBLEMS.

The topography in most parts of the region, except in the vicinity of streams, is gently rolling or even mountainous in the higher elevations. The region is generally cleared of forest trees, although vast areas of cut-over or stump land are found. The farms vary in size from less than 100 acres to more than 1,000 acres. The land is especially adapted for grazing purposes. In most sections there is tillable land for the production of abundant crops for winter feed or other purposes.

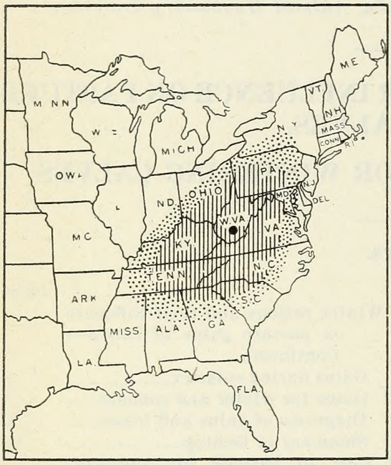

FIG. 1.—Map showing region to which this work applies. The black dot indicates the location of the farm on which the experiment was conducted. The shaded portion represents the area to which the results are applicable, and the dotted portion shows an additional area to which the results apply in part.

It is in this general area that a large percentage of the grass-finished cattle which go annually to eastern markets are produced. The fact that most of the steers raised in this area are finished for market from grass alone attests the value of the pastures, which consist largely of blue grass. The use of grain for finishing cattle is not general, although there are many sections where the practice is followed, particularly in the valleys of some of the larger streams. By far the larger number of farmers who handle beef cattle grow either stockers and feeders or finish cattle for market from grass alone. It therefore becomes one of the principal beef-production problems in this general area to determine the best and most economical method of wintering the cattle and the one that will enable them to make the best possible use of the pasture the following summer, the time when the cheapest gains are made. A common practice in this area has been to winter steers on dry feed, such as hay, corn stover, and wheat straw, and on corn silage to a less extent, in a way that causes them to lose materially in weight. They are then pastured the following summer and sold from grass either as stockers or feeders or as finished steers for the market. There are some who hold the idea that it is profitable to permit this loss of weight, which with older steers often amounts to from 25 to 100 pounds. Others believe that cattle wintered on silage, or on a ration of which silage is a part, will not do well on grass the following summer.

OBJECTS AND PLAN OF THE WORK.

The experiments as a whole had these general problems in view:

1. To ascertain the effect of different wintering rations upon subsequent pasture gains.
2. To determine the most satisfactory and economical method of wintering.
3. To determine the best method and the cost of raising beef cattle in West Virginia.

Two distinct phases of the problems as above outlined presented themselves for solution: First, the keeping of grade beef cows to raise calves; second, the wintering of calves, yearlings, and 2-year-olds that are to be pastured the following summer and sold as stockers, feeders, or fat cattle. This bulletin takes up the work with calves. The results of the work with yearlings and cows are published in United States Department of Agriculture Bulletins 870 and 1024, respectively.

The work was carried on for a period of three years, in order to have an average of feeds, cattle, seasons, and other conditions tending to produce variation. The general plan of the experiments, including the rations used for the different lots of calves, is given in Table 1.

TABLE 1.—*Plan of the three years' work.*

Lot No.	Season.	Calves in lot.	Winter feed.	Summer feed.
1	1916–17	10	Corn silage, rye hay, and cottonseed meal.	Pasture.
	1917–18	10	.....do	Do.
	1918–19	10	.....do	Do.
2	1916–17	10	Corn silage and clover hay	Do.
	1917–18	10	.....do	Do.
	1918–19	10	.....do	Do.
3	1916–17	10	Mixed hay and grain mixture[1]	Do.
	1917–18	10	.....do	Do.
	1918–19	10	.....do	Do.

[1] Grain mixture, parts by weight: 3 parts corn, 1 part bran, 1 part linseed meal.

KIND OF CALVES USED.

The calves used were grade Shorthorn, Hereford, and Aberdeen Angus. They were raised in southern West Virginia and were a good, uniform lot in age, weight, quality, and condition. They ranged in weight from 300 to 500 pounds, averaging 385 pounds at the beginning of the winter period, and were 1 year old the following spring.

FEEDS USED.

Samples of each of the feeds used were taken at different times during the winter periods and sent to the department of chemistry, West Virginia Agricultural Experiment Station, Morgantown.

W. Va., to be analyzed. The averages of these analyses are given in Table 2 in heavy type. The average analyses for several thousand other samples are also shown for comparison.

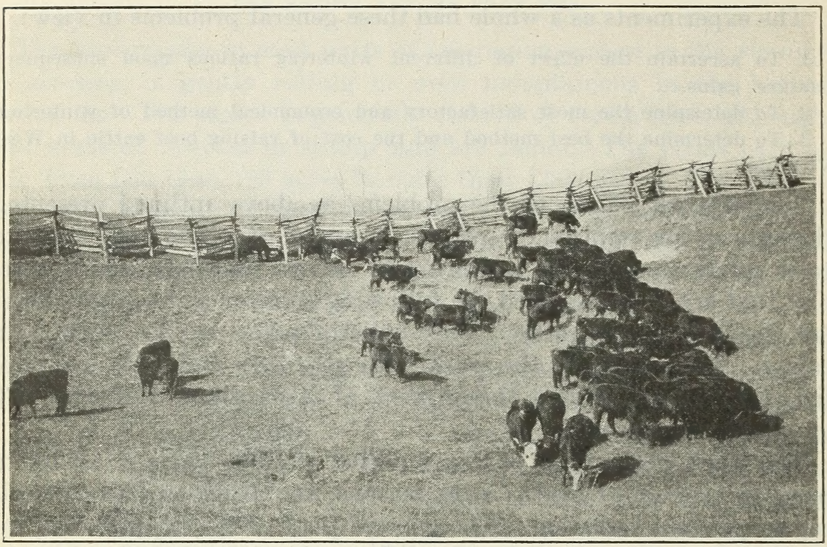

FIG. 2.—The type of calves and pasture used in the experimental work.

TABLE 2.—*Composition of feeds used.*

Feed.	Moisture.	Ash.	Protein.	Carbohydrates, including fiber.	Fat.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Corn silage	**75**	**1.1**	**1.9**	**21.5**	**0.5**
	70.9	1.4	2.4	24.4	.9
Mixed hay	**8.3**	**3.7**	**6.6**	**79.5**	**1.9**
Rye hay	**8.5**	**4.7**	**5.8**	**79.8**	**1.2**
	6.4	4.7	5.9	81	2
Clover hay	**8.6**	**4.4**	**8.7**	**76.6**	**1.7**
	12.9	6.9	13.6	63.2	3.4
Shelled corn	**12.6**	**1.3**	**9**	**73**	**4.1**
	12.9	1.3	9.3	72.2	4.3
Wheat bran	**10.2**	**5.3**	**15**	**65.9**	**3.6**
	9.6	5.9	16.2	64.1	4.2
Linseed meal	**8.4**	**6.3**	**30**	**48.1**	**7.2**
	8.9	5.4	34.5	44.4	6.8
Cottonseed meal	**7.8**	**6**	**37.6**	**40.3**	**8.3**
	7.3	5.8	36.8	43.5	6.6

From the analyses it is evident that the feeds used were somewhat below the average in quality. The cottonseed meal was slightly better than the average of that which is graded as good by the Association of Feed Control Officials of the United States. The silage was made from a mixture of dent and silage corn.

A three-year rotation of crops, consisting of corn, wheat, and hay, is practiced quite generally in the section under discussion. Timothy is sown with the wheat in the fall and red clover is sown on the same field in the spring. This provides in the year following the wheat crop a mixed hay of approximately one-half timothy and one-half clover. The mixed hay used in this work was obtained in this manner.

In making rye hay the seed is sown in the fall, as it would be for raising grain, except that more seed per acre is used. In the spring, just before the rye blooms, it is cut and cured.

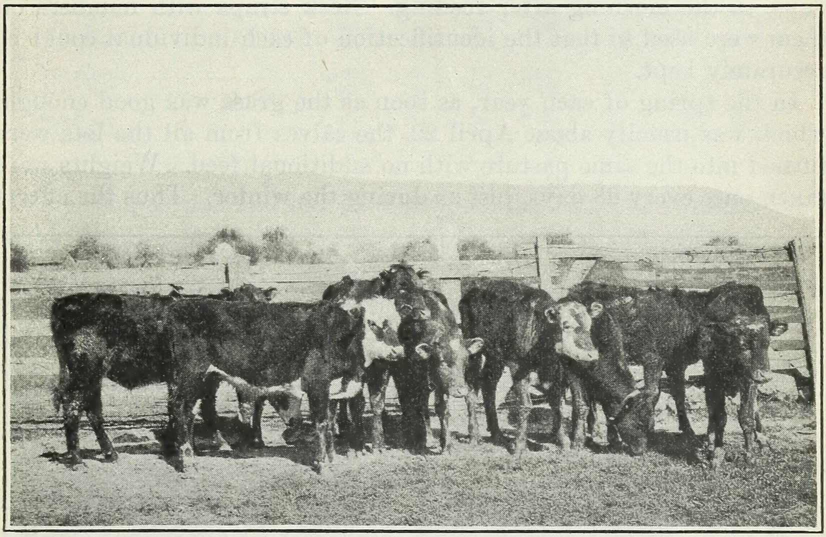

FIG. 3.—Lot 1, calves fed corn silage, rye hay, and cottonseed meal. Photographed at the end of the winter period, April 25, 1919.

CHARACTER OF PASTURE.

Each year the calves were turned on to a rather rough, hilly pasture of about 200 acres, one-half of which is woodland. A small stream, which flows through the pasture, provides an abundance of fresh water at all times throughout the summer.

The soil is of limestone formation. A fairly good growth of blue grass with white clover is found on all parts of the pasture not in timber. Under normal climatic conditions there is rainfall enough to keep the grass growing throughout the season. However, the latter part of the summer of 1917 was so dry that the calves made only small gains, as shown in figures 6, 7, and 8.

METHOD OF FEEDING AND HANDLING THE CALVES.

In the fall before starting the calves on winter feed they were divided into lots of 10 each. In making this division care was taken to have the lots as nearly uniform as possible in quality, breeding, size, and condition. The different lots were given the same amount of space in open sheds with small outside lots about 30 by 60 feet in size. Water was supplied in these lots at all times and salt was constantly available. The calves were fed twice a day.

The feed, both concentrates and roughages, was weighed at each feeding, and accurate records of it kept. The calves were weighed at the beginning and at the end of the feeding period, the weights being taken three days in succession and the average taken as their initial and final weights. They were also weighed once every 28 days, in the morning after feeding. Neck straps with numbers on them were used so that the identification of each individual could be accurately kept.

In the spring of each year, as soon as the grass was good enough, which was usually about April 22, the calves from all the lots were turned into the same pasture with no additional feed. Weights were taken once every 28 days, just as during the winter. Thus the effects of the different rations upon the summer grazing of the different lots could be studied.

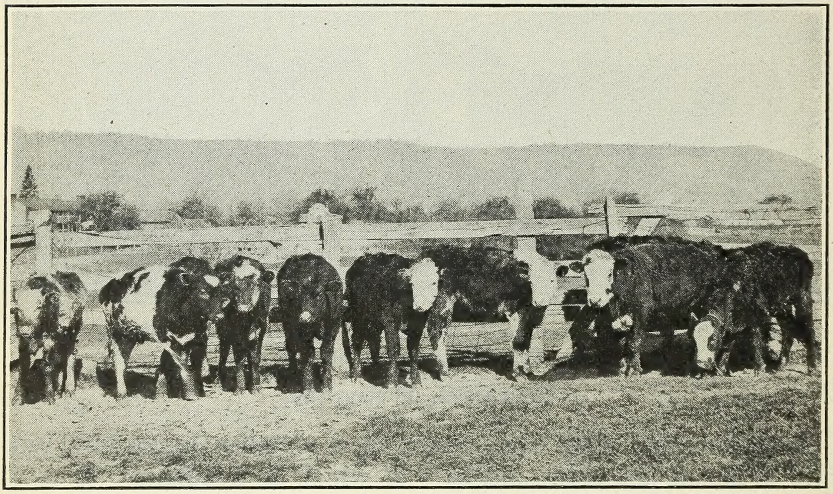

FIG. 4.—Lot 2, calves fed corn silage and clover hay. Photographed at the end of the winter period, April 25, 1919.

I. WINTER RATIONS AND THEIR INFLUENCE ON PASTURE GAINS OF CALVES.

QUANTITY OF FEED CONSUMED.

In considering the quantity of feed consumed it should be kept in mind that the calves were not getting fattening rations, but only enough to keep them in thrifty growing condition. Table 3 shows the total amount of different feeds eaten in the various lots and the average daily ration per calf in each lot during each of the three winters.

TABLE 3.—*Average total and daily rations per calf during three winters.*

Ration.	Total feed per calf.				Daily feed per calf.			
	1916–17 (133 days).	1917–18 (134 days).	1918–19 (135 days).	Average (134 days).	1916–17 (133 days).	1917–18 (134 days).	1918–19 (135 days).	Average (134 days).
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Lot 1:								
Corn silage	1,596	1,608	1,730	1,645	12.0	12.0	12.8	12.3
Rye hay	560	536	478	525	4.2	4.0	3.5	3.9
Cottonseed meal	66	67	101	78	.5	.5	.7	.6
Lot 2:								
Corn silage	1,596	1,608	1,730	1,645	12.0	12.0	12.8	12.3
Clover hay	661	736	561	653	5.0	5.0	4.2	4.9
Lot 3:								
Mixed hay	1,064	1,284	1,346	1,231	8.0	9.6	10.0	9.2
Grain mixture	383	402	270	352	2.9	3.0	2.0	2.6

The composition and nutritive ratio of the rations fed are given in Table 4.

TABLE 4.—*Quantities of dry matter, digestible nutrients, and nutritive ratios of the daily rations.*

Lot No.	Daily ration per calf.	Dry matter.	Digestible nutrients.			Feed per 1,000 pounds live weight.[2]
			Protein.	Carbohydrate equivalent.[1]	Nutritive ratio.	
		Pounds.	*Pounds.*	*Pounds.*		*Pounds.*
1.	Corn silage (12.3 pounds)	3.07	0.17	2.32		32.0
	Rye hay (3.9 pounds)	3.57	.12	1.77		10.2
	Cottonseed meal (0.6 pound)	.55	.19	.25		1.6
	Total	7.19	.48	4.34	1 : 9	
2.	Corn silage (12.3 pounds)	3.07	.17	2.32		31.9
	Clover hay (4.9 pounds)	4.48	.41	2.12		12.7
	Total	7.55	.58	4.44	1 : 7.7	
3.	Mixed hay (9.2 pounds)	8.44	.53	4.04		24.0
	Grain mixture (2.6 pounds)	2.31	.33	1.66		6.8
	Total	10.75	.86	5.70	1 : 6.6	

[1] The carbohydrate equivalent is the sum of the digestible carbohydrates plus 2.25 times the digestible fat.

[2] Rations based on the initial weights of the calves.

From Table 4 it is seen that the ration given Lot 3 provided considerably more dry matter than the rations given Lots 1 and 2, the two latter being nearly the same. Lot 3 also received more total digestible nutrients than the other two lots.

GAINS DURING WINTER.

The gains and losses in weight during each of the three winters are shown in Table 5.

TABLE 5.—*Total and daily gains during three winters.*

Lot No.	Ration.	Season.	Number of calves.	Days on feed.	Average initial weight per calf.	Average weight per calf at end of winter.	Total gain per calf.	Daily gain per calf.
				Days.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1	Corn silage, rye hay, and cottonseed meal	1916–17	10	133	426	482	56	0.42
		1917–18	10	134	344	386	42	.31
		1918–19	10	135	383	449	66	.49
	Average		10	134	384	439	55	.41
2	Corn silage and clover hay	1916–17	10	133	429	470	41	.31
		1917–18	10	134	342	386	44	.33
		1918–19	10	135	383	438	55	.41
	Average		10	134	385	431	46	.34
3	Mixed hay and grain	1916–17	10	133	429	502	73	.55
		1917–18	10	134	340	442	102	.76
		1918–19	10	135	384	502	118	.87
	Average		10	134	384	482	98	.73

Table 5 shows that the gains for each of the three winters are quite uniform in the case of each ration.

GAINS DURING SUMMER.

Table 6 shows the weights at the beginning of the grazing period, the weights at the end of the grazing period, and the total and average gains per calf for the summer period.

TABLE 6.—*Total and daily gains during three summers on pasture.*

Lot No.	Previous winter ration.	Season.	Number of calves.	Days on pasture.	Average weight per calf at beginning of grazing period.	Average final weight per calf.	Total gain per calf.	Daily gain per calf.
				Days.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1	Corn silage, rye hay, and cottonseed meal	1916–17	10	168	482	667	185	1.10
		1917–18	10	168	386	590	204	1.21
		1918–19	10	168	449	640	191	1.14
	Average		10	168	439	632	193	1.15
2	Corn silage and clover hay	1916–17	10	168	470	687	217	1.29
		1917–18	10	168	386	580	194	1.16
		1918–19	10	168	438	602	164	.98
	Average		10	168	431	623	192	1.14
3	Mixed hay and grain	1916–17	10	168	502	695	193	1.15
		1917–18	10	168	442	623	181	1.08
		1918–19	10	168	502	674	172	1.02
	Average		10	168	482	664	182	1.08

GAINS FOR WINTER AND SUMMER.

The gains in weight for both winter and summer are summarized in Table 7, with averages for the three years.

TABLE 7.—*Summary of gains in weight per calf, winter and summer.*

Lot No.	Ration.	Season.	Gain per calf in winter.	Gain per calf in summer.	Total gain per calf.	Daily gain per calf.
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1	Corn silage, rye hay, and cottonseed meal	1916–17	56	185	241	0.80
		1917–18	42	204	246	.81
		1918–19	66	191	257	.85
	Average		55	193	248	.82
2	Corn silage and clover hay	1916–17	41	217	258	.85
		1917–18	44	194	238	.79
		1918–19	55	164	219	.73
	Average		46	192	238	.79
3	Mixed hay and grain	1916–17	73	193	266	.88
		1917–18	102	181	283	.94
		1918–19	118	172	290	.96
	Average		98	182	280	.93

DIAGRAMS OF GAINS AND LOSSES.

The four charts, figures 6, 7, 8, and 9, show the gains and losses of the calves by 28-day periods. The first three show the effects of the three rations under comparison for the three years they were used, one chart being used for each ration. The fourth chart shows the average gains for three years for each of the three rations.

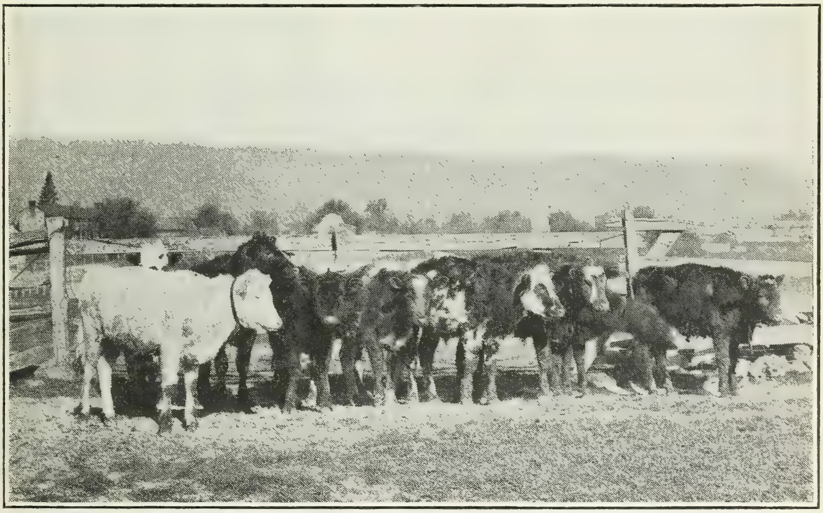

FIG. 5.—Lot 3, calves fed mixed hay and a grain mixture. Photographed at the end of the winter period, April 25, 1919.

Horizontal distance on the chart indicates the number of days that the calves were fed during the three winters and pastured during the three summers. The date on which each monthly period began is given also. The average length of the total period for the three years was 302 days, of which 134 days were in the winter, or feeding period, and the remaining 168 in the summer, or grass period. The heavy black vertical line near the center of the chart marks the dividing line between the winter and summer periods.

Vertical distance on the chart represents changes in live weights of the calves. The weights corresponding to each of the horizontal lines are given along the left side of the chart.

Figure 6, for Lot 1, shows that the calves gained in weight very uniformly for the three years. They lost in weight only during the last 22 days of the winter period of 1917–18 and the dry month of August, 1917.

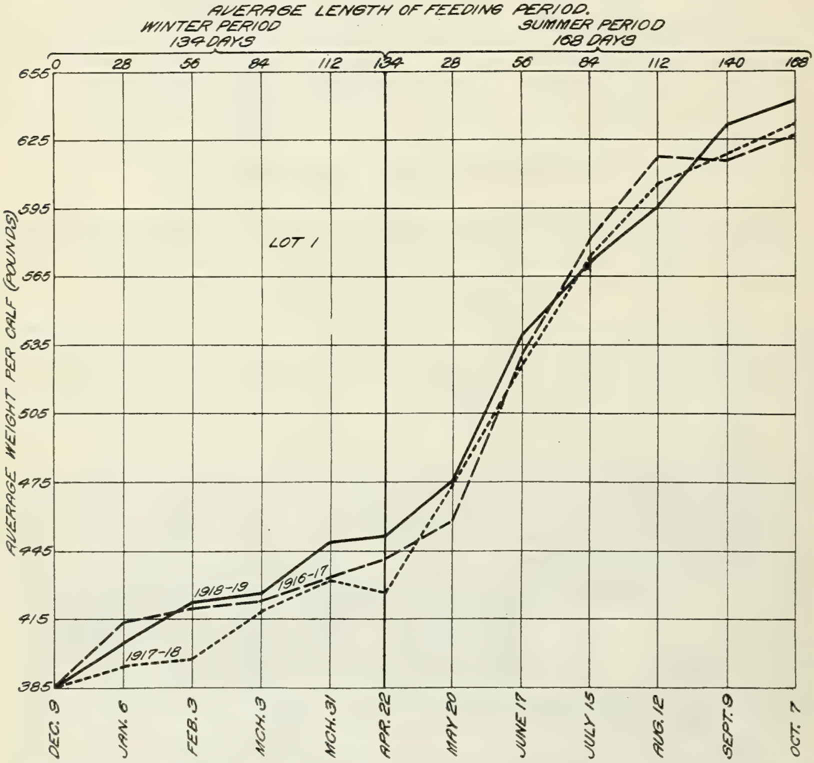

FIG. 6.—Annual results of winter and summer (grass) feeding for Lot 1. These calves were fed the following ration during the winter: Corn silage, 12.3 pounds; rye hay, 3.9 pounds; cottonseed meal, 0.6 pound.

Figure 7, for Lot 2, shows that the calves gained in weight uniformly for the three years, except that the summer gains for 1916–17 were considerably greater than for the two subsequent years. They also lost in weight during the last part of the winter period of 1916–17 and during the last 28 days on grass in 1918–19.

Figure 8, for Lot 3, shows that the calves gained in weight uniformly for the three years, except the periods just before and just after they were turned to pasture. They also lost weight slightly in August, 1917. With these exceptions the calves each year gained uniformly during the first 28 days, but not nearly so much as they gained during the second 28 days on pasture. While the calves in Lot 3 gained much more than those of Lots 1 and 2 during the winter periods, they did not make so much gain as Lots 1 and 2 on pasture. Those which gained most or lost least during the winter made the least gains on grass.

SUMMARY OF FEEDING.

1. The following quantities of feed per day per calf averaging 385 pounds in weight at the beginning of the winter feeding period produced the corresponding gains in live weight for 134 days.

Lot No.	Average daily ration.	Pounds.	Total winter gain.
			Pounds.
1	Corn silage	12.3	55
	Rye hay	3.9	
	Cottonseed meal	.6	
2	Corn silage	12.3	46
	Clover hay	4.9	
3	Mixed hay	9.2	98
	Grain mixture	2.6	

2. The calves which made the greatest winter gain (Lot 3) also made the greatest total gain for the year, although they did not gain so much during the summer period as calves which put on less gain during the winter. Similar results, which are published in Department of Agriculture Bulletin No. 870, were obtained in handling yearling steers.

3. In wintering calves 4.9 pounds of clover hay (Lot 2) are practically equal to 3.9 pounds of rye hay and 0.6 pound of cottonseed meal (Lot 1) as a supplement to corn silage.

II. COST OF RATIONS FOR WINTERING CALVES.

Whether to purchase calves in the fall and carry them through the winter largely on roughage or to purchase them in the spring after some one else has wintered them is a question which the thoughtful cattle grazier tries to answer. No matter what the answer may be on any particular farm or in any particular section of the country, the fact remains that cattle are generally higher in price and are worth more in the spring just before the grass season opens than they were at the close of the pasture period the preceding fall. This increase in value is due to the cost of wintering and the demand for cattle to make use of grass in the spring. In the following discussion the various winter rations are compared to determine which is the cheapest per day, and especially which produces a pound of gain most cheaply. For this purpose it is necessary to fix the prices for feeds on the farm. It is felt, however, that this is the most questionable and unsatisfactory part of such experimental work, especially for the last few years, during which unusual fluctuations have occurred in feed prices. On account of these fluctuations and also for simplicity in making the various calculations an average of the feed prices for the three years is used, as follows:

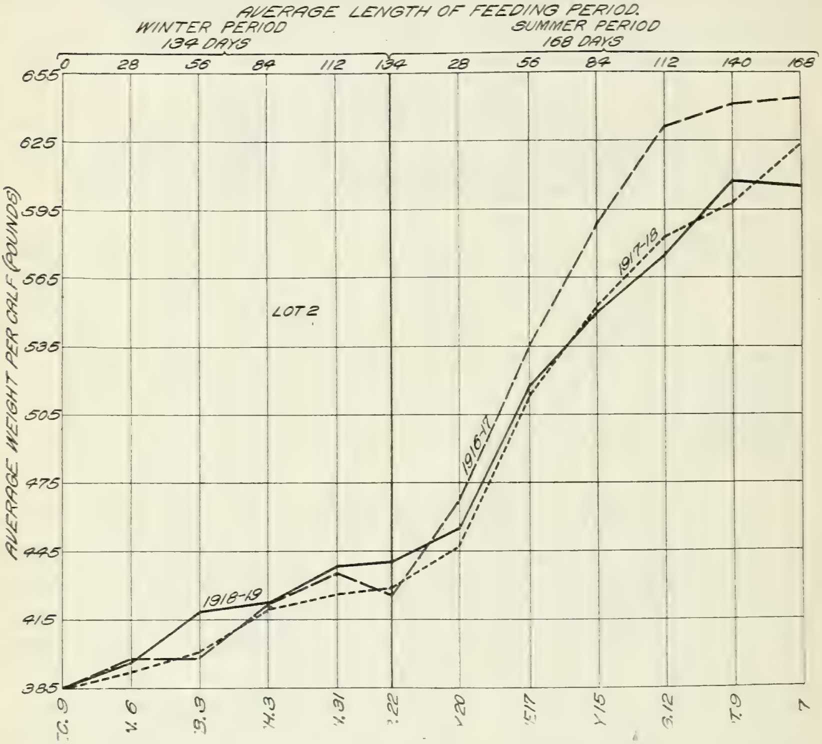

FIG. 7.—Annual results of winter and summer (grass) feeding for Lot 2. These calves were fed the following ration during the winter period: Corn silage, 12.3 pounds; clover hay, 4.9 pounds.

Corn silage	per ton	$6.00
Rye hay	do	18.00
Cotttonseed meal	do	50.00
Clover hay	do	17.00
Mixed hay	do	18.00
Corn	per bushel	0.96
Wheat bran	per ton	40.00
Oil meal	do	56.00
Mixed grain	do	39.76
Pasture	per day	0.03

The foregoing figures are based on the average farm prices from 1910 to 1919 as given in the Yearbook of the United States Department of Agriculture for the States of West Virginia, Virginia, Maryland, Pennsylvania, Ohio, Kentucky, Tennessee, and North Carolina.

When one wishes to determine which ration should be used in a particular feeding operation, it is suggested that he apply local prices to the average amounts of the feeds consumed per calf, as given in Table 4.

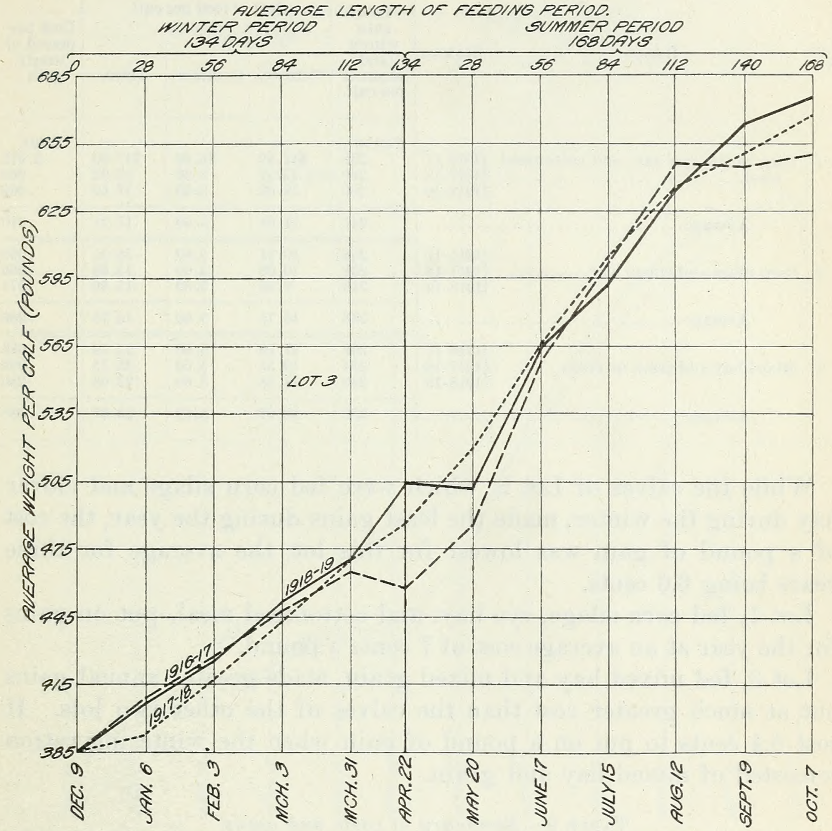

FIG. 8.—Annual results of winter and summer (grass) feeding for Lot 3. These calves were fed the following ration during the winter periods: Mixed hay, 9.2 pounds; grain mixture, 2.6 pounds.

COST PER POUND OF GAIN.

From Table 8 it will be noted that the winter cost constitutes approximately two-thirds of the total cost for the year. Most of the gain, however, is made during the summer or pasture season. Hence, the cost of wintering becomes the chief factor governing the cost of a pound of gain.

The cost of producing a pound of gain is one of the main factors in determining whether a calf is being produced at a profit or loss. It is considered that the cost of labor and other expenses are balanced by the manure produced.

TABLE 8.—*Costs of feeding.*

Lot No.	Ration.	Season.	Total gain winter and summer per calf.	Cost of feed per calf.			Cost per pound of yearly gain.
				Winter.	Summer.	Total.	
			Pounds.				*Cents.*
1	Corn silage, rye hay, and cottonseed meal	1916-17	238	$11.49	$5.60	$17.09	0.072
		1917-18	246	11.32	5.60	16.92	.069
		1918-19	256	12.02	5.60	17.62	.069
	Average		247	11.61	5.60	17.21	.070
2	Corn silage and clover hay	1916-17	258	10.41	5.60	16.01	.062
		1917-18	238	10.08	5.60	15.68	.066
		1918-19	219	9.96	5.60	15.56	.071
	Average		238	10.15	5.60	15.75	.066
3	Mixed hay and grain mixture	1916-17	266	17.19	5.60	22.79	.086
		1917-18	283	19.55	5.60	25.15	.089
		1918-19	290	17.48	5.60	23.08	.080
	Average		280	18.07	5.60	23.67	.085

While the calves of Lot 2, which were fed corn silage and clover hay during the winter, made the least gains during the year, the cost of a pound of gain was lowest for this lot, the average for three years being 6.6 cents.

Lot 1, fed corn silage, rye hay, and cottonseed meal, put on gains for the year at an average cost of 7 cents a pound.

Lot 3, fed mixed hay and mixed grain, made greater annual gains but at much greater cost than the calves of the other two lots. It cost 8.4 cents to put on a pound of gain when the wintering ration consisted of mixed hay and grain.

TABLE 9.—*Summary of costs and gains.*

Item.	Lot 1.	Lot 2.	Lot 3.
Average cost of wintering	$11.61	$10.15	$18.07
Average length of winter periods ....days	134	134	134
Average gain per calf, winter ....pounds	54	47	98
Cost of feeds per day, winter	$0.087	$0.076	$0.135
Average cost of summer feed	$5.60	$5.60	$5.60
Average length of summer periods ....days	168	168	168
Average gain per calf, summer ....pounds	193	192	182
Cost per day, summer	$0.033	$0.033	$0.033
Average total cost per year	$17.21	$15.75	$23.67
Average total gains per calf ....pounds	247	239	280
Cost per pound yearly gain	$0.07	$0.066	$0.084

SUMMARY OF COSTS.

1. Corn silage and clover hay, fed to Lot 2, was the cheapest ration used and cost the least per pound of yearly gain.

2. Lot 3, fed mixed hay and grain, made a large gain but cost $6.46 more per year per calf than Lot 1, and $7.92 more per year per calf than Lot 2. Therefore, a ration containing silage for wintering steer calves is more economical than dry roughage with grain, considering the gains made both during the winter and in the summer following.

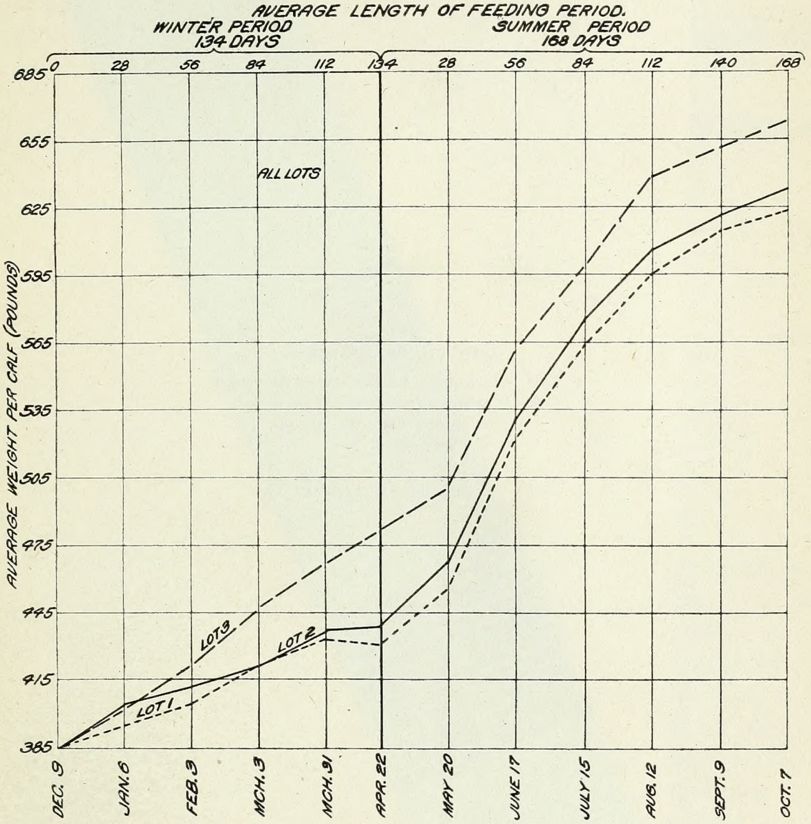

FIG. 9.—Average results of winter and summer (grass) feeding for the 3 lots fed in winter, as follows: Lot 1—Corn silage, 12.3 pounds; rye hay, 3.9 pounds; cottonseed meal, 0.6 pound. Lot 2—Corn silage, 12.3 pounds; clover hay, 4.9 pounds. Lot 3—Mixed hay, 9.2 pounds; grain mixture, 2.6 pounds.

3. The cost of wintering a steer calf is approximately two-thirds the cost of keeping the calf one year. The profit, therefore, is determined largely by the cost of the winter ration.

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